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**Antrim Wind Energy**  
*Third Party Sound Measurement Protocol*  
*in Response to*  
*Post-Construction Noise Complaints*

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On March 17, 2017, the New Hampshire Site Evaluation Committee (NH SEC) issued a Certificate of Site and Facility (Certificate) to Antrim Wind Energy (AWE) to site, to construct with all associated civil and electrical infrastructure, and to operate 9 Siemens SWT-3.2-113 direct drive wind turbines capable of generating 3.2 MW each, for a total nameplate capacity of 28.8 MW. Page 9 of the Certificate contains the following condition: *“the Applicant shall retain a third-party noise expert, as approved by the Administrator of the Committee, to assist the Town of Antrim and the Administrator in taking field measurements in order to evaluate and validate noise complaints.”*

This document describes a third-party sound measurement protocol to be implemented by Cavanaugh Tocci on behalf of the NH SEC and the Town of Antrim, in response to their receipt of complaints of AWE facility sound at nearby locations. Cavanaugh Tocci will complete these measurements in full cooperation with TransAlta, the AWE owner, who will provide weather and wind turbine operating information as may be needed.

## Sound Level Limits

Limits on AWE sound are set forth in N.H. Admin. R., Site 301.14(f)(2)a. as follows:<sup>1</sup>

*“With respect to sound standards, the A-weighted equivalent sound levels produced by the applicant’s energy facility during operations shall not exceed the greater of 45 dBA or 5 dBA above background levels, measured at the L-90 sound level, between the hours of 8:00 a.m. and 8:00 p.m. each day, and the greater of 40 dBA or 5 dBA above background levels, measured at the L-90 sound level, at all other times during each day, as measured using microphone placement at least 7.5 meters from any surface where reflections may influence measured sound pressure levels, on property that is used in whole or in part for permanent or temporary residential purposes, at a location between the nearest building on the property used for such purposes and the closest wind turbine...”*

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<sup>1</sup> The Certificate is also conditioned upon AWE’s compliance with the terms and conditions contained in the Agreement entitled: “Agreement Between Town of Antrim New Hampshire and Antrim Wind Energy LLC, Developer/Owner of the Antrim Wind Power Project” dated March 8, 2012 (“the Agreement”). The Agreement was amended, effective January 16, 2018, and is incorporated by reference to the Certificate at Appendix V. Paragraph 11 of the Agreement, contains provisions regarding “Noise Restrictions.” However, the Certificate contains the following condition: “In the event of a conflict between the requirements of the Agreement and the Certificate, the Certificate shall control.” Certificate at page 6. Accordingly, the Certificate and the N.H. Admin. R. Site 100 *et seq.* shall govern the third party testing.

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## Response to Complaints

In the event of a complaint of AWE sound by a resident and determined by the NH SEC to warrant measurement, N.H. Admin. R., Site 301.18 (i) provides that:

*Validation of noise complaints submitted to the committee shall require field sound surveys, except as determined by the administrator to be unwarranted, which field studies shall be conducted under the same meteorological conditions as occurred at the time of the alleged exceedance that is the subject of the complaint.*

A measurement protocol specifically in response to a complaint is not defined in the rules. However, Site 301.18(e) requires post-construction noise compliance monitoring and provides some details for long-term and short-term measurement of AWE sound at residential locations. The monitoring provisions are general and require some specific interpretations as discussed below.

## Initial Site Visits

On February 12, 2020, Cavanaugh Tocci staff, accompanied by NH SEC personnel, made an initial, non-measurement visit to the residences of the two complainants. These visits had the primary purpose of interfacing with the residents to familiarize them with the measurement procedures, as well as where and how measurements will be made on their property generally in accordance with the provisions in N.H. Admin. R., Site 301.18 (e) and (i).

## Measurement scheduling

AWE will alert Cavanaugh Tocci when the following conditions are forecasted during the 6:00 pm -10:30 pm time frame that day:<sup>2</sup>

- Hub-height wind speeds are predicted to be 7.0 m/s or higher;
- Wind direction is predicted between 200 to 300 degrees (North = 0 degree);
- Electrical power generation to be at least 0.985 MW per turbine (this value corresponds to the threshold at which the turbines operate at full sound power, 106.0 dBA;
- Ambient temperature at the microphone locations will exceed 15 degrees F; and
- The absence of precipitation.

Cavanaugh Tocci will make every effort to mobilize and to conduct measurements on that day. If staff or equipment are not available, Cavanaugh Tocci will decline to measure and AWE will alert them on a subsequent day when desired conditions are again met, until measurements have been completed.

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<sup>2</sup> The forecasted conditions correlate with a review of operational data during the estimated dates and times provided by the Complainants to ensure that the field measurements are conducted under the same meteorological conditions as occurred at the time of the alleged exceedance.

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## Measurements

1. **Sound measurements (w/ background measured)** will be performed at two complainant locations using Bruel & Kjaer 2250 (IEC Class 1) sound level meters.
  - a. Meters will be tripod-mounted and fitted with windscreens, and will be calibrated prior to and after each measurement session.
  - b. Microphones will be mounted 1-2 m above the grade and 7.5 m or more from buildings and other reflecting surfaces. 10-meter cables will connect the microphones to the measurement units to help isolate observer noise from the measurement.
  - c. Meters will be calibrated before and after measurements using a Bruel & Kjaer Type 4231 calibrator. Calibration data will be recorded and included in project documentation.
  - d. A- and C-weighted hourly equivalent sound levels ( $LA_{eq,1-hr}$  and  $LC_{eq,1-hr}$ ) will be measured to determine whether AWE sound levels exceed the limits in N.H. Admin. R., Site 301.14(f)(2)a.<sup>3</sup>
  - e. [Measured sound levels will be taken at 0.100-second intervals and used to](#) ~~The 1-hour measurement intervals will be~~ comprised of 5-min subintervals ( $LA_{eq,5-min}$  and  $LC_{eq,5-min}$ ). [1-hour measurement intervals will be comprised of 5-min subintervals.](#) On-site observers will note noise events that may have contaminated the data. Those 5-min samples noted as potentially contaminated may be dropped from the hourly statistics or amended using [the data taken at 0.100-second intervals -ms-logged-data](#). (See 3. below). Among other 1-hour and 5-min descriptors measured will be the  $LAF_{90}$ ,  $LAF_{10}$ ,  $LCF_{90}$ , and the  $LCF_{10}$ . ( $LCF_{90}$  and the  $LCF_{10}$  must be computed from other measured 5-min Z-weighted 1/3 octave band data). Measurements will be performed using fast meter response.
  - f. To facilitate data review by the Cavanaugh Tocci,  $LA_{eq,100ms}$  sound levels will be logged, and audio waveform data will be stored. These data will be used to eliminate or amend contaminated data and will not be reported.
2. **Wind Speed** will be monitored near both microphones using a Davis Vantage VUE system. This system measures wind speed and direction, and temperature. These measurements will be used to determine whether wind speeds at the microphones are within specified operating ranges for the sound level meter and windscreen, and if not, corrections will be made based on Bruel and Kjaer data for microphone self-noise spectra with windscreen at a range of wind speeds.

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<sup>3</sup> Background sound levels will be subtracted from measured levels to determine the AWE-alone sound levels for compliance evaluation. This would be done using the logarithmic averages of the 5 minutes samples, free of transient sound, and using the following formula: AWE sound level = Total sound level ( $Leq$ ) minus (logarithmically) background sound level ( $Leq$ ). This allows a fair and representative comparison of the A-weighted equivalent sound levels produced by the applicant's energy facility, AWE, to the applicable limits.

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3. **Observer monitoring** – Cavanaugh Tocci staff will attend both meters for 2 daytime and 2 nighttime hours while the turbines are in operation, plus a 30 minute pre-scheduled period during the night while all of the turbines are shut down (6:00 PM – 10:30 PM). These hours were chosen to best address the times reported by the complainants, and to provide coverage during both daytime (8 AM – 8 PM) and nighttime hours (8 PM – 8 AM), and are consistent with the requirements for post-construction monitoring. This interval may be shifted earlier or later to better match conditions to the meteorological conditions as required by N.H. Admin. R., Site 301.18 (i). The observer will note any events that may have influenced sound measurements and the times at which these events occurred. Examples of such events include weather conditions, turbine operation, indigenous sounds, streams, and wind in vegetation.
4. **Background sound measurements.** To address the “5 dBA above background levels” limit in N.H. Admin. R., Site 301.14(f)(2)a., and to determine the contribution of background sound to measured AWE sound, all wind turbines will be shut down for a period of 30 minutes. The arithmetic average of the measured LAF<sub>90,5-min</sub> sound levels will be the “background levels” to which 5 dBA is added for the background-based limits on turbine sound. 5-minute intervals, which include turbine spin-down and spin-up, will be excluded from the hourly results.
5. **Tone assessment.** If audible tones are observed by Cavanaugh Tocci staff during the field measurements, methods of ANSI S12.9 Part 3 (2013) Annex B will be used to evaluate tonality. If AWE sound is determined to be tonal in accordance with the standard annex, measured AWE sound levels will be increased by 5 dBA as per Site 301.18(h).
6. **Operational data.** AWE will provide actual hub-height wind speed and direction, as well as power generation, in 10-minute intervals for the duration of field sound monitoring.<sup>4</sup>
7. **Reporting.** Within 15 days after the completion of each measurement session, a report evaluating compliance of AWE facility sound with applicable limits will be prepared and submitted to the NH SEC and the Town of Antrim. The NH SEC will post the report on its website. The general format of the data to be presented is exhibited in Appendix A.

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<sup>4</sup> Shorter intervals, e.g. 5 minutes, are not available in AWE’s SCADA system. 10 minutes intervals are the shortest available in AWE’s SCADA system.

# Appendix A

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## Data Presentation Format

		Location: XXX Residence, Road, Town, NH						
		Date	Feb. xx, 2020					
Pre-measurement Calibration		5:52 PM	94.0	dB @ 1000 Hz				
Post-measurement Calibration		10:04 PM	94.0	dB @ 1000 Hz				
Time	LAeq,1-hr	Time	LAeq,5-min	Transient?	Valid 5-min Samples	Adj LAeq,1-hr	Notes	
6:00:00 PM	70	7:00:00 PM	80		80	70		
		7:05:00 PM	50		50			
		7:10:00 PM	39		39			
		7:15:00 PM	60		60			
		7:20:00 PM	51		51			
		7:25:00 PM	50		50			
		7:30:00 PM	50		50			
		7:35:00 PM	42		42			
		7:40:00 PM	57		57			
		7:45:00 PM	60	x				
		7:50:00 PM	61		61			
		7:55:00 PM	60		60			
7:00:00 PM	81	8:00:00 PM	50		50	79		
		8:05:00 PM	45		45			
		8:10:00 PM	46		46			
		8:15:00 PM	74		74			
		8:20:00 PM	87	x				
		8:25:00 PM	86	x				
		8:30:00 PM	61		61			
		8:35:00 PM	60		60			
		8:40:00 PM	61	x				
		8:45:00 PM	77		77			
		8:50:00 PM	87		87			
		8:55:00 PM	82		82			
8:00:00 PM	74	9:00:00 PM	80	x		67		
		9:05:00 PM	74		74			
		9:10:00 PM	72		72			
		9:15:00 PM	76	x				
		9:20:00 PM	80	x				
		9:25:00 PM	50	x				
		9:30:00 PM	39		39			
		9:35:00 PM	60		60			
		9:40:00 PM	51		51			
		9:45:00 PM	50		50			
		9:50:00 PM	50		50			
		9:55:00 PM	42		42			
9:00:00 PM	79	10:00:00 PM	57		57	79		
		10:05:00 PM	60		60			
		10:10:00 PM	61		61			
		10:15:00 PM	60		60			
		10:20:00 PM	50		50			
		10:25:00 PM	45		45			
		10:30:00 PM	46		46			
		10:35:00 PM	74		74			
		10:40:00 PM	87		87			
		10:45:00 PM	86		86			
		10:50:00 PM	61		61			
		10:55:00 PM	60		60			
10:00:00 PM	61	11:00:00 PM	61		61	61		